



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 947 816 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
13.06.2001 Bulletin 2001/24

(51) Int Cl.7: **G01L 9/12, G01L 9/00**

(43) Date of publication A2:
06.10.1999 Bulletin 1999/40

(21) Application number: **99105163.2**

(22) Date of filing: **30.03.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **31.03.1998 JP 8544498**
31.03.1998 JP 8564198
21.09.1998 JP 26642698

(71) Applicants:
• **Hitachi, Ltd.**
Chiyoda-ku, Tokyo 101-8010 (JP)
• **Hitachi Car Engineering Co., Ltd.**
Hitachinaka-shi, Ibaraki 312-0062 (JP)

(72) Inventors:
• **Horie, Junichi**
Hitachinaka-shi, Ibaraki 312-0063 (JP)
• **Onose, Yasuo**
Naka-gun, Ibaraki 319-1102 (JP)

- **Ichikawa, Norio**
Mito-shi, Ibaraki 311-4146 (JP)
- **Kuryu, Seiji**
Hitachinaka-shi, Ibaraki 312-0041 (JP)
- **Shimada, Satoshi**
Hitachi-shi, Ibaraki 319-1224 (JP)
- **Saito, Akihiko**
Hadano-shi, Kanagawa 259-1322 (JP)
- **Hanzawa, Keiji**
Mito-shi, Ibaraki 310-0836 (JP)
- **Matsumoto, Masahiro**
Hitachi-shi, Ibaraki 316-0024 (JP)
- **Moriya, Hiroshi**
Niihara-gun, Ibaraki 315-0054 (JP)
- **Yasukawa, Akio**
Kashiwa-shi, Chiba 277-0084 (JP)
- **Miyazaki, Atsushi**
Mito-shi, Ibaraki 310-0912 (JP)

(74) Representative: **Beetz & Partner Patentanwälte**
Steinsdorfstrasse 10
80538 München (DE)

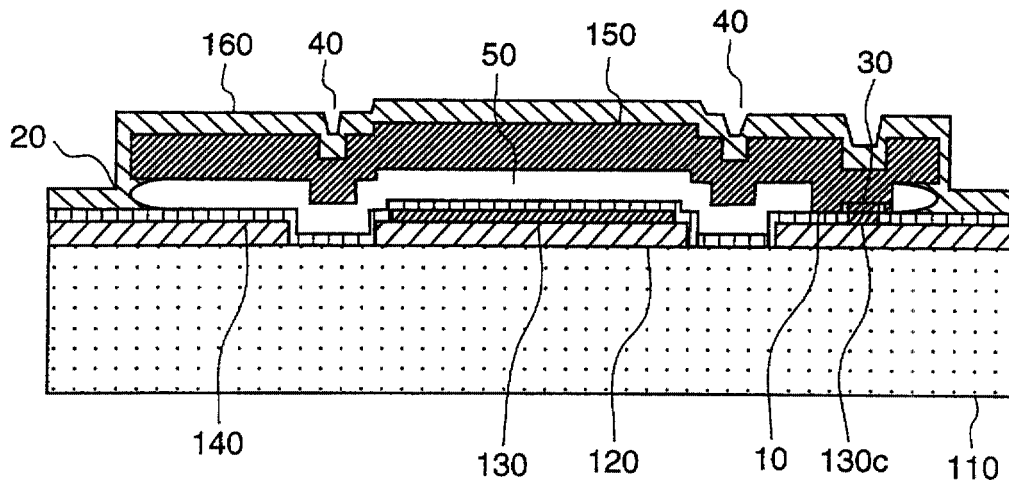
(54) **Capacitive type pressure sensor**

(57) By sealing a diaphragm (150) with less processes and lower cost and reducing deformation due to remaining stress, a stable and highly reliable pressure sensor construction is proposed. The pressure sensor is low in measurement error and small in floating capacitance and leakage current and good in characteristic. As a means to attain the above object, a polycrystalline silicon diaphragm (150) is sealed with a silicon oxide film

(160) deposited through a LPCVD method and then completely covered. The diaphragm (150) is placed on a surface of a semiconductor substrate (110) with a nearly constant gap of 0.15 to 1.3 μm , and has difference-in-grade constructions (40) of a deformation reducing means due to remaining stress.

EP 0 947 816 A3

FIG.3





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 10 5163

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 849 071 A (EVANS ALAN G R ET AL) 18 July 1989 (1989-07-18)	1	G01L9/12 G01L9/00
Y	* column 3, line 12 - line 17; figures 1-3 *	2,4,6	
A	* column 5, line 4 - line 5 * * column 4, line 13 - line 15 * * column 4, line 38 - line 45 * ---	3,7	
Y	EP 0 385 574 A (UNITED TECHNOLOGIES CORPORATION) 5 September 1990 (1990-09-05) * page 5, line 5 - line 35 *	2,6	
P,Y	DE BRUYKER D ET AL: "A combined piezoresistive/capacitive pressure sensor with self-test function based on thermal actuation" SENSORS AND ACTUATORS A,CH,ELSEVIER SEQUOIA S.A., LAUSANNE, vol. 66, no. 1-3, 1 April 1998 (1998-04-01), pages 70-75, XP004143971 ISSN: 0924-4247 * page 70, right-hand column, line 2 - line 11; figure 1 * -----	4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			G01L
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		21 December 2000	MUCS, A
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.92 (P04C01)



European Patent
Office

Application Number
EP 99 10 5163

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-7



European Patent
Office

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 99 10 5163

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-7

a capacitive pressure sensor with 0.15 to 1.3
micrometer gap and sealed by silicon oxide film
deposited by LPCVD and method to produce the same.

2. Claims: 8-16

a capacitive pressure sensor with electromagnetic
shielding and reference pressure chamber

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 10 5163

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-12-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4849071 A	18-07-1989	GB 2198611 A	15-06-1988
EP 385574 A	05-09-1990	US 4998179 A	05-03-1991
		BR 9000734 A	22-01-1991
		CA 2010803 A,C	31-08-1990
		DE 69007516 D	28-04-1994
		DE 69007516 T	04-08-1994
		IL 93540 A	13-05-1993
		JP 2918272 B	12-07-1999
		JP 3081635 A	08-04-1991
		KR 137931 B	15-05-1998
		US 5245504 A	14-09-1993